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Claims

1. A method including steps for

compressing, at a first cache, an object stored at said first cache;

coupling a compressed version of said object from said first cache to a second cache.

decompressing, at said second cache, an uncompressed version of said object.

2. A method as in claim 1, wherein said second cache can only recover an uncompressed object from said compressed object in response to a contents of said second memory.

3. A method as in claim 1, wherein said second cache can recover an uncompressed object from said compressed object without further information.

4. A method as in claim 1, wherein said steps for compressing include steps for determining a known function of a first object at said first cache;

said compressed version includes a result of said known function;

1 said steps for decompressing include steps for determining said known
2 function of a second object at said second cache, and comparing said compressed version
3 with a result of said known function of said second object.

4
5 5. A method as in claim 4, wherein said known function is substantially
6 irreversible.

7
8 6. A method including steps for
9 determining, at a first cache, a first object signature responsive to said first
10 object;
11 coupling said first object signature to a second cache;
12 comparing, at said second cache, said first object signature with a function
13 of at least one second object;
14 refraining from transmitting said first object in response to said steps for
15 comparing.

16
17 7. A method as in claim 6, including steps for
18 coupling a result of said steps for comparing to said first cache; and
19 coupling said first object to said second cache responsive to said compari-
20 son result.

21
22 8. A method as in claim 6,

1 including steps for storing at said first cache information whether said first
2 object is likely to be stored at said second cache;

3 wherein said steps for transmitting said object signature are responsive to
4 said information.

5
6 9. A method including steps for
7 determining, at a first cache, first information regarding a likelihood
8 whether an object received from a server is stale;

9 determining, at a second cache, second information regarding a likelihood
10 whether said object will be requested by a client;

11 coupling said first information and said second information between said
12 first memory and said second memory;

13 discarding said object at first cache disposed in response to said second in-
14 formation; and

15 discarding said object at said second cache disposed in response to said first
16 information.

17
18 10. A method including steps for

19 storing a first object at a first cache;

20 determining an object signature at said first cache in response to said object;

21 transmitting said object signature to a second cache;

1 comparing said object signature with a function of at least one object stored
2 at said second cache;

3 transmitting said first object to said second cache in response to said steps
4 for comparing.

5
6 11. A method as in claim 10,
7 including steps for storing at said first cache information whether said first
8 object is likely to be stored at said second cache;

9 wherein said steps for transmitting said object signature are responsive to
10 said information.

11
12 12. A method as in claim 10, including steps for transmitting a result of
13 said steps for comparing to said first cache.

14
15 13. A method including steps for
16 storing, at a first cache, a first object and first information regarding
17 whether to discard said first object;

18 storing, at a second cache, a second object and second information regard-
19 ing whether to discard said second object;

20 coupling said first information to said second cache; and

21 discarding said second object in response to said first information and in
22 response to said second information.

1
2 14. A method as in claim 13, including steps for

3 coupling said second information to said first cache; and

4 discarding said first object in response to said first information and in re-
5 sponse to said second information.

6
7 15. A method as in claim 13, wherein said first information includes a
8 likelihood of said object being stored at said second cache.

9
10 16. A method including steps for

11 storing, at a first cache, an object from a server and first information re-
12 garding said object at said server;

13 storing, at a second cache, an object for delivery to a client and second in-
14 formation regarding requests for said object by said client;

15 transmitting said first information from said first cache to said second
16 cache;

17 transmitting said second information from said second cache to said first
18 cache;

19 whereby said first cache and said second cache can collectively operate
20 more effectively.

21
22 17. A system including

1 a first cache disposed for being coupled to a server, and having memory for
2 storing an object from said server and for storing first information regarding said object at
3 said server;

4 a second cache disposed for being coupled to a client, and having memory
5 for storing said object for delivery to said client and for storing second information re-
6 garding requests for said object by said client;

7 a first communication path between said first cache and said second cache,
8 disposed for transmitting said first information from said first cache to said second cache;

9 a second communication path between said first cache and said second
10 cache, disposed for transmitting said second information from said second cache to said
11 first cache;

12 whereby said first cache and said second cache can collectively operate
13 more effectively.

14
15 18. A system including

16 a first cache disposed for being coupled to a server, and having memory for
17 storing an object from said server, said object having an associated object signature;

18 a second cache disposed for being coupled to a client, and having memory
19 for storing said object for delivery to said client;

20 a communication path between said first cache and said second cache,
21 whereby said first cache can transmit either said object signature or said object to said
22 second cache;

1 whereby said first cache can refrain from transmitting said object to said
2 second cache when said object is already stored at said second cache.

3
4 19. A system as in claim 18; including a communication path between
5 said second cache and said first cache, whereby said second cache can transmit a result of
6 a comparison between said object signature and said object at said second cache.

7
8 20. A system as in claim 18, including a communication path
9 coupling said object signature to said second cache;
10 coupling a result of a comparison between said object signature and a func-
11 tion of said object at said second cache; and
12 coupling said object to said second cache responsive to said comparison re-
13 sult.

14
15 21. A system as in claim 18, including
16 a first communication path coupling said object signature to said second
17 cache;
18 a second communication path coupling to said first cache a result of a com-
19 parison between said object signature and a function of said object at said second cache;
20 and
21 a third communication path coupling said object to said second cache re-
22 sponsive to said comparison result.

1
2 22. A system as in claim 18, including

3 a third cache disposed for being coupled to a second client, and having
4 memory for storing said object for delivery to said second client;

5 a communication path between said first cache and said third cache,
6 whereby said first cache can transmit either said object signature or said object to said
7 third cache;

8 whereby said first cache can refrain from transmitting said object to said
9 third cache when said object is already stored at said third cache.

10
11 23. A system as in claim 18, including memory at said first cache in-
12 cluding information whether said object is likely to be stored at said second cache.

13
14 24. A system including

15 a first cache including a first memory and an information compressor;

16 a second cache including a second memory and an information decompres-
17 sor; and

18 a communication path disposed for coupling a compressed object from said
19 first cache to said second cache.

20
21 25. A system as in claim 24, wherein

22 said first memory includes a first object;

1 said information compressor includes a known function;

2 said communication path is disposed for coupling to said second cache a

3 first result of said known function applied to said first object;

4 said second memory includes a second object;

5 said information decompressor includes said known function, and a com-

6 parison between said first result and a second result of said known function applied to

7 said second object;

8 whereby said second cache is disposed for determining that said second

9 object is substantially identical to said first object in response to a result of said compari-

10 son.

11
12 26. A system as in claim 25, wherein said known function is substan-
13 tially irreversible.

14
15 27. A system as in claim 24, wherein said information compressor is
16 lossy.

17
18 28. A system as in claim 24, wherein said second cache can only recover
19 an uncompressed object from said compressed object in response to a contents of said
20 second memory.

1 29. A system as in claim 24, wherein said second cache can recover an
2 uncompressed object from said compressed object without further information.

3
4 30. A system including
5 a first cache including a first object and a first object signature responsive to
6 said first object;

7 a second cache including a second object, said second cache coupled to said
8 first object signature;

9 said first cache coupled to a result of a comparison between said first object
10 signature and a second object signature responsive to said second object;

11 whereby said first cache can refrain from transmitting said first object in
12 response to said comparison.

13
14 31. A system as in claim 30, including a communication path
15 coupling said first object signature to said second cache;
16 coupling said comparison result to said first cache; and
17 coupling said first object to said second cache responsive to said compari-
18 son result.

19
20 32. A system as in claim 30, including
21 a first communication path coupling said first object signature to said sec-
22 ond cache;

1 a second communication path coupling said comparison result to said first
2 cache; and

3 a third communication path coupling said first object to said second cache
4 responsive to said comparison result.

5
6 33. A system as in claim 30, including

7 a third cache including a third object, said third cache coupled to said first
8 object signature;

9 said first cache coupled to a result of a second comparison between said
10 first object signature and a third object signature responsive to said third object;

11 whereby said first cache can refrain from transmitting said first object in
12 response to said second comparison.

13
14 34. A system as in claim 30, including information at said first cache
15 whether said transmitting said first object is likely to be desirable.

16
17 35. A system including

18 a first cache including a first object and first information regarding whether
19 to discard said first object;

20 a second cache coupled to said first information, said second cache includ-
21 ing a second object and second information regarding whether to discard said second ob-

1 ject, said second cache disposed for discarding said second object in response to said first
2 information and in response to said second information.

3

4 36. A system as in claim 35, wherein

5 said first cache is coupled to said second information and is disposed for
6 discarding said first object in response to said first information and in response to said
7 second information.

8

9 37. A system as in claim 35, wherein said first information includes a
10 likelihood of said object being stored at said second cache.

11

12 38. A system including

13 a first cache including first information regarding a likelihood whether an
14 object received from a server is stale;

15 a second cache including second information regarding a likelihood
16 whether said object will be requested by a client;

17 a communication path capable of coupling said first information and said
18 second information between said first memory and said second memory;

19 said first cache disposed for discarding said object in response to said sec-
20 ond information; and

21 said second cache disposed for discarding said object in response to said
22 first information.

1
2 39. A system including

3 a first memory including a first object received from a server and a first
4 object signature responsive to said first object;

5 a second memory including a second object ready for delivery to a client;

6 a communication path capable of coupling said first object signature to said
7 second memory;

8 a comparator coupled to said second memory and to said communication
9 path, responsive to whether a second object signature responsive to said second object is
10 substantially identical to said first object signature;

11 said communication path capable of coupling an output of said comparator
12 to said first memory;

13 whereby said first memory can refrain from delivering said first object to
14 said second memory in response to said output of said comparator.

15
16 40. A system including

17 a plurality of caches, each including memory;

18 a communication network coupling each said cache to substantially all other
19 said caches;

20 at least a first said cache having an object in its memory and disposed to
21 transmit said object to a second said cache only if said second cache does not already
22 have said object in its memory.

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41. A system as in claim 40, including memory at said first cache including information whether said object is likely to be stored at said second cache.

42. A system as in claim 40, wherein said communication network couples an object signature for said object to said second cache; couples to said first cache a result of a comparison between said object signature and a function of said object at said second cache; and couples said object to said second cache responsive to said comparison result.

43. A system as in claim 40, wherein said first cache includes a first signature function coupled to memory for said first cache; said second cache includes a second signature function coupled to memory for said second cache, and a comparator coupled to said first signature function and said second signature function; wherein said first cache refrains from transmitting said first object in response to said comparator.

44. A system including a set of root caches disposed for receiving a data item from a set of servers;

1 a set of leaf caches disposed for delivering said data item to a set of clients,
2 at least one of said leaf caches being coupled to at least one of said root caches;

3 wherein said root caches and said leaf caches include memory having said
4 data item stored therein after an initial use of said data item;

5 wherein said data item has an associated item signature, said item signature
6 being responsive to said data item;

7 wherein if a server returns a second data item substantially identical to said
8 one data item, said one root cache transmits said item signature to said one leaf cache;

9 whereby said one root cache refrains from transmitting said data item more
10 than once to said one leaf cache.

11

12 45. A system as in claim 44, wherein said set of root caches and said set
13 of leaf caches are disposed in a tree structure.

14

15 46. A system as in claim 44, wherein said set of root caches has exactly
16 one member.

17

18 47. A system as in claim 44, including memory in said one root cache
19 indicating for each particular said leaf cache whether said particular leaf cache is likely to
20 have said data item in its memory.

21

22 48. A method including steps for

1 associating, at both a source and a destination, a tag value with a dictionary
2 element;

3 if said dictionary element is present at said destination, transmitting, from
4 said source to said destination, said tag value in place of said dictionary element;

5 if said dictionary element is not present at said destination, transmitting,
6 from said source to said destination, said dictionary element.

7
8 49. A method including steps for

9 providing a set of associations, at both a source and a destination, each as-
10 sociation including a tag value and a dictionary element;

11 possibly discarding one or more of said set of associations at said destina-
12 tion;

13 transmitting, from said source to said destination, a selected tag value or its
14 associated dictionary element, in response to said steps for possibly discarding.

15
16 50. A method as in claim 49, including steps for

17 transmitting, from said destination to said source, an indication responsive
18 to said steps for possibly discarding;

19 whereby if said dictionary element is still present at said destination, said
20 source does not need to transmit said dictionary element to said destination.

21
22 51. A method including steps for

1 transmitting a dictionary element from a source to a destination;

2 associating, at both said source and said destination, a tag value with said

3 dictionary element;

4 possibly discarding said dictionary element at said destination;

5 transmitting, from said source to said destination, said tag value or said dic-

6 tionary element in response to said steps for possibly discarding.

7
8 52. A method as in claim 51, including steps for

9 transmitting, from said destination to said source, an indication responsive

10 to said steps for possibly discarding;

11 whereby if said dictionary element is still present at said destination, said

12 source does not need to transmit said dictionary element to said destination.

13
14 53. Unreliable dictionary compression.

15
16 54. A method as in claim 53, wherein a set of dictionary elements for

17 said method each includes an entire object deliverable from a server to a client.

18
19 55. A method as in claim 53, wherein a set of dictionary elements for

20 said method includes at least one object larger than one kilobyte.

21
22 56. A system including

means for associating, at both a source and a destination, a tag value with a dictionary element;

means, if said dictionary element is present at said destination, for transmitting, from said source to said destination, said tag value in place of said dictionary element;

means, if said dictionary element is not present at said destination, for transmitting, from said source to said destination, said dictionary element.

57. A system including

means for providing a set of associations, at both a source and a destination, each association including a tag value and a dictionary element;

means for possibly discarding one or more of said set of associations at said destination;

means for transmitting, from said source to said destination, a selected tag value or its associated dictionary element, in response to said steps for possibly discarding.

58. A system as in claim 57, including

means for transmitting, from said destination to said source, an indication responsive to said steps for possibly discarding;

whereby if said dictionary element is still present at said destination, said source does not need to transmit said dictionary element to said destination.

1

2

59. A system including

3

means for transmitting a dictionary element from a source to a destination;

4

means for associating, at both said source and said destination, a tag value

5

with said dictionary element;

6

means for possibly discarding said dictionary element at said destination;

7

means for transmitting, from said source to said destination, said tag value

8

or said dictionary element in response to said steps for possibly discarding.

9

10

60. A system as in claim 59, including

11

means for transmitting, from said destination to said source, an indication

12

responsive to said steps for possibly discarding;

13

whereby if said dictionary element is still present at said destination, said

14

source does not need to transmit said dictionary element to said destination.